Dec. 29, 1964 C. FULOP 3,163,237

IMPACT DRILL

Filed Oct. 21, 1963 2 Sheets-Sheet 1

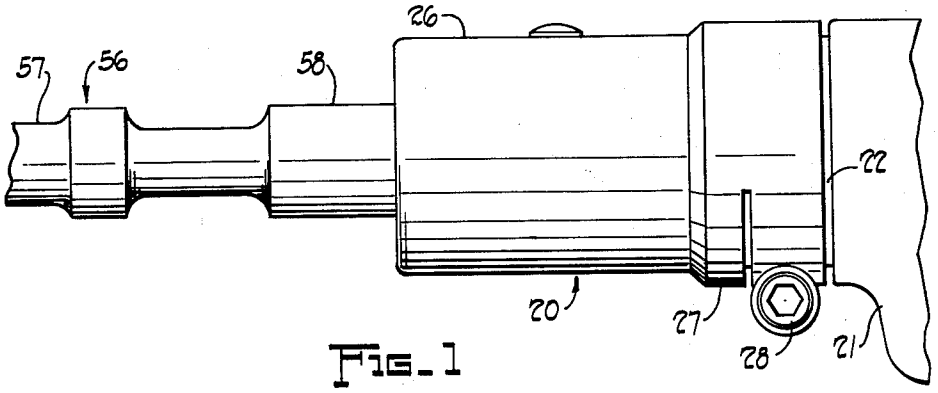



Fig. 1

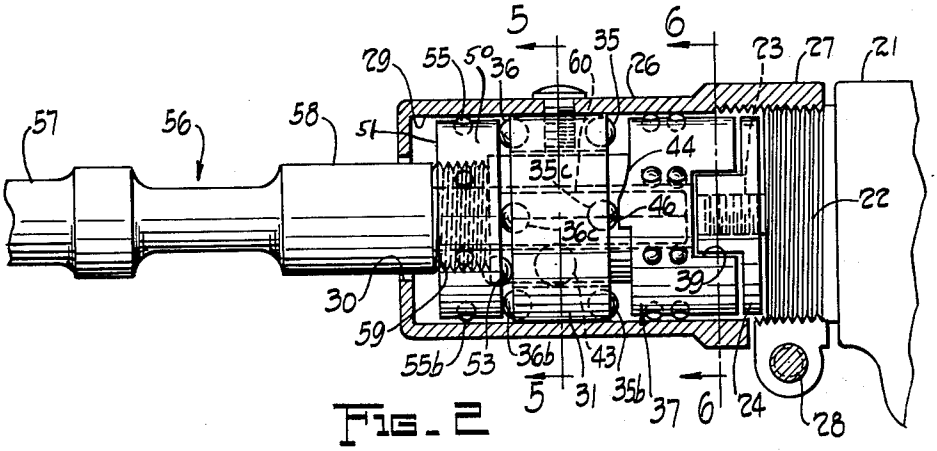



Fig. 2

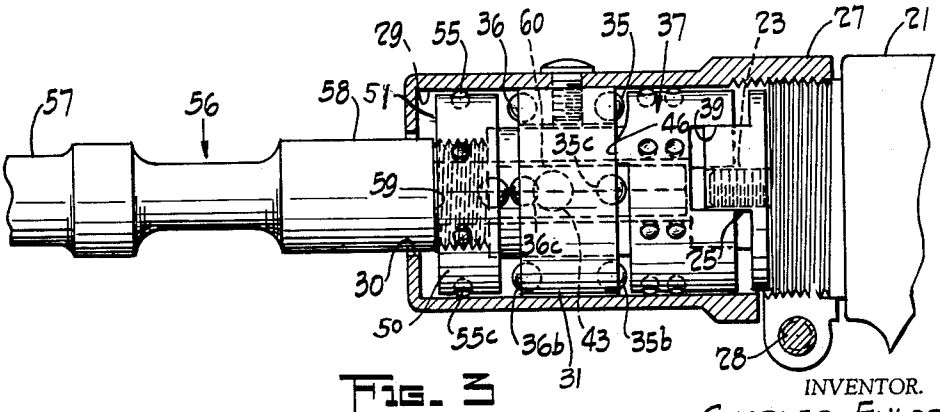



Fig. 3

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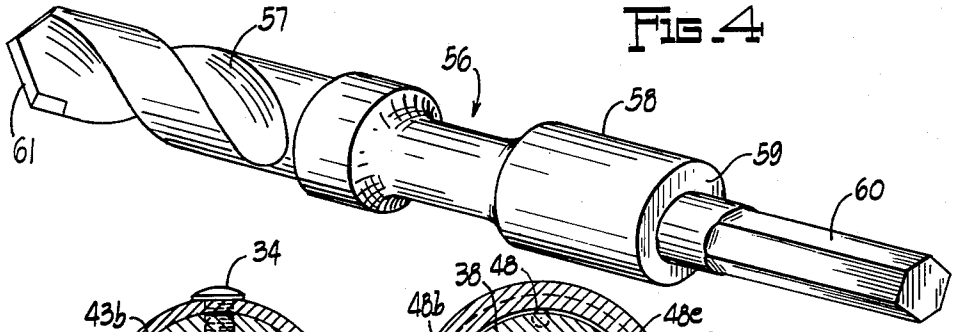
BY Sanford Schwimmacher
ATTORNEY.

Dec. 29, 1964 C. FULOP 3,163,237

IMPACT DRILL

Filed Oct. 21, 1963 2 Sheets-Sheet 2

Fig. 4



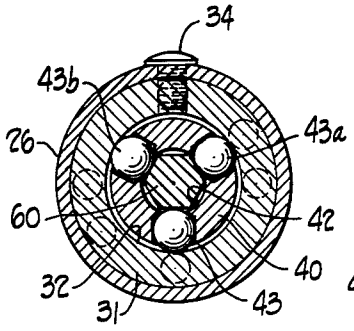




Fig. 5

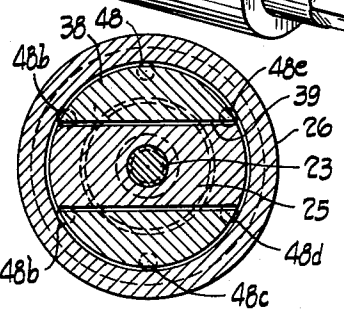



Fig. 6

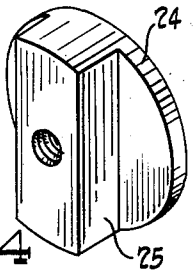



Fig. 14

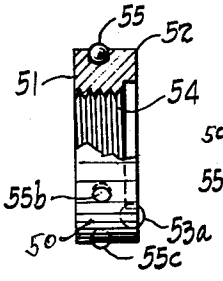



Fig. 7

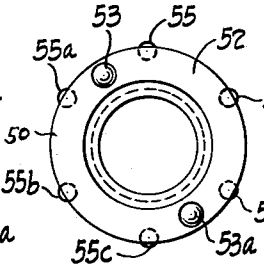



Fig. 8

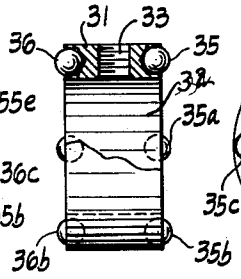



Fig. 9

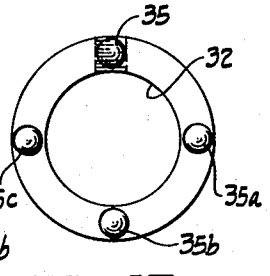



Fig. 10

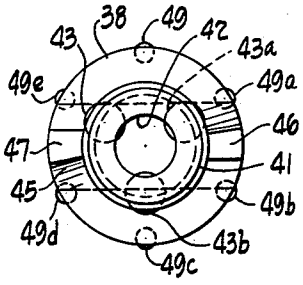



Fig. 11

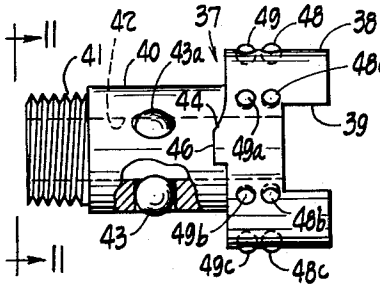



Fig. 12

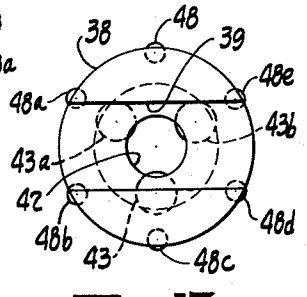



Fig. 13

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3,163,237

# IMPACT DRILL

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6 Claims. (Cl. 173—109)

This invention relates generally to tools and particularly to a rotary impact drill in which the drill bit is engaged with the impacting element through a free floating axial fit.

Conducive to a better understanding of the invention it may be well to point out that the drilling of holes in brick, concrete, rock, cinder-block, or similar materials, combines a cutting and chipping action that requires that the drill bit be simultaneously rotated and axially impacted.

In prior art drills, the tool bit is mounted on the motor drive shaft, or a spindle forming a continuation thereof, by means of a chuck, or similar holding device, and is intermittently struck by a reciprocating spring-biased hammer element actuated by the rotation of the drive shaft.

In such machines there is no actual displacement of the bit by the hammer blows, since the bit is anchored on the shaft, but the effect is a vibrating or jarring one, which makes the drill hard to hold. Furthermore, the energy exerted by the machine in compressing the hammer throwing spring before each impact results in a kick-back toward the hand of the operator, which must be resisted by the operator, and further contributes to operational fatigue.

The primary object of this invention, therefore, is to provide an impact drill wherein both the drill and hammer element are free to float relative to each other and the motor drive shaft.

Another object is to provide an impact drill whose hammer is made to reciprocate without the use of any biasing spring.

Still another object is to provide a true hammering action, with the drill bit free to move away from the hammer striker-face, after impact.

A further object is to provide a device of the type stated whose hammer element has an axial bore therethrough which acts as a socket for holding the drill bit.

Another object is to provide a non-circular free fit between the hammer bore and the drill bit, whereby the drill bit is held against rotation relative to the hammer, but is free to float longitudinally of its axis of rotation without restraint, even to the point of complete disengagement.

These, and other objects of the invention will become apparent from a reading of the following specification and claims, together with the accompanying drawing, wherein like parts are referred to and indicated by like reference numerals, and wherein:

FIGURE 1 is a side elevational view of the impact drill that is the subject of this invention;

FIGURE 2 is a longitudinal view, partly in section, showing the free floating drill bit and hammer in a first position;

FIGURE 3 is a view similar to that of FIGURE 2, but showing the free floating drill bit and hammer in a second position;

FIGURE 4 is a perpective view of a carbide tipped drill bit, adapted for use with this device, shown in its dismounted condition;

FIGURE 5 is a cross-sectional view taken along the line and in the direction of the arrows 5—5 of FIGURE 2;

FIGURE 6 is a cross-sectional view taken along the line and in the direction of the arrows 6—6 of FIGURE 2;



FIGURE 7 is a side view, partly in section, of the striking head of the hammer;

FIGURE 8 is a right end view of the same;

FIGURE 9 is a side view, partly in section, of the hammer shaft bearing block;

FIGURE 10 is a right end view of the same;

FIGURE 11 is a view taken along the line and in the direction of the arrows 11—11 of FIGURE 12;

FIGURE 12 is a side view, partly in section, of the hammer member showing it without its striking head;

FIGURE 13 is a right end view of the same; and

FIGURE 14 is a perspective view of the unmounted clutch key member.

Referring more particularly to the drawing, there is seen in FIGURE 1 the impact drill that is the subject of this invention, broadly indicated by reference numeral 20.

Reference numeral 21 indicates the case of a portable electric motor of the type capable of being held in the manner of a conventional electric drill.

The motor case has a protruding drive shaft 23 centered in an externally threaded collar 22.

Reference numeral 26 indicates a cylindrical housing mounted on the motor case collar 22 through an internally threaded mating collar 27, and held in locked engagement therewith through a clamp bolt 28.

The housing 26 has bore 29 therethrough bounded at its outer end by a closure cap having an opening 30 for the passage of the shank 58 of a drill bit, broadly indicated by reference numeral 56, therethrough.

In speaking of the hollow housing 26, locations proximate the motor case mounting collar 27 are referred to as rear or "inward," and locations proximate the housing opening 30 are referred to as forward or "outward."

A stationary cylindrical bearing block 31 is mounted through a force fit at the approximate midpoint of the housing bore 29, and is locked in place by a screw 34 engaged in a threaded hole 33.

The block 31 has an axial bearing bore 32, therethrough and four freely rotatable cam follower balls 35, 35*a*, 35*b* and 35*c*, mounted in the inward end face thereof, as seen in FIGURE 10.

Four similar, and aligned, freely rotatable cam follower balls, 36, 36*a*, 36*b* and 36*c* are positioned in the outward end face, as seen in FIGURE 5.

Reference numeral 37 broadly indicates a hammer, or plunger, member which is journaled through the bearing block bore 32 for free reciprocation and rotation therein.

The plunger 37 has a central shaft 40 bounded by a cylindrical clutch head 38 and a cylindrical striker head 50, both of larger diameter than the shaft portion.

The plunger 37 acts in the manner of a unitary structure, but in order to permit it to be mounted with its shaft 40 extending through the bearing block 31, the forward end 41 of the shaft is threaded to receive the hammer head 50's threaded bore 54, which is engaged therewith after the shaft 40 is inserted through the bearing block bore 32, as seen in FIGURES 2 and 3.

The plunger member 37 has an axial bore 42 therethrough, which serves as a socket for the shank 60 of the drill 56, as explained hereinafter.

Three ball bearings 43, 43*a* and 43*b*, as seen most clearly in FIGURE 5, are mounted for free rotation through the wall of the shaft bore 42.

The balls 43, 43*a* and 43*b* extend through both the outer and inner faces of the shaft 40 so that they contact both the wall of the bore 32 of the bearing block 31 and three faces of a hexagonal shaped drill shank inserted in the plunger shaft bore 42, as is seen most clearly in FIGURE 5.

The hammer head 50 has 6 spaced, freely rotatable,

ball bearings 55, 55*a*, 55*b*, 55*c*, 55*d* and 55*e*, mounted in its peripheral edge, engaged with the wall of the bore 29 of the housing 26.

The cylindrical clutch head 38 has two series of six freely rotatable, spaced ball bearings 48, 48*a*, 48*b*, 48*c*, 48*d* and 48*e*, and 49, 49*a*, 49*b*, 49*c*, 49*d* and 49*e*, mounted in its peripheral edge which also engage the wall of housing bore 29.

It will be evident that these 4 series of bearing balls, namely 43, 48, 49 and 55, provide friction free surfaces on which the plunger unit 37 may rotate and reciprocate within the housing 26, relative to the bearing block 31.

The clutch head 38 has a diametric slot 39 which mates with the driving key 25 of a clutch disc 24 mounted on the threaded end 23 of the motor drive shaft, as seen in FIGURES 2 and 3.

There is a sliding fit between the key 25 and the slot 39, as is seen most clearly in FIGURE 6, so that the plunger unit 37 is positively rotated by the key 25 but is free to reciprocate longitudinally of its axis in the bearing block 31, relative thereto, as seen in FIGURES 2 and 3.

The forward face of the clutch head has two diametrically spaced cam teeth 44 and 45 which are inclined gradually upward to flat upper faces 46 and 47, respectively, which have sharp drop-off points.

These cam teeth face toward and are engageable with the cam follower balls 35, 35*a*, 35*b* and 35*c* of the bearing block 31.

The hammer head 50 has a circular cam track 52 on its inner face in which are embedded two freely rotatable cam balls 53 and 53*a*, diametrically spaced in positions immediately beyond the projected planes of the drop-off points of the clutch head cam surfaces 46 and 47.

The cam balls 53 and 53*a* are engageable with the cam follower balls 36, 36*a*, 36*b* and 36*c* of the bearing block 31.

A study of FIGURES 2 and 3 will show that when the cam teeth 44 and 45 ride with their high surfaces 46 and 47 bearing against the cam follower balls 35, the entire plunger, or hammer, unit is positioned in its first, or retracted, position, as seen in FIGURE 2.

As rotation continues the high points 46 and 47 of the cam teeth 44 and 45, pass beyond their cam followers 35, etc., leaving the plunger 37 free to travel forward along its axis within the bearing block 31.

Immediately thereafter the hammer head cam balls 53 and 53*a* engage the cam follower balls 36, etc., which cause the hammer striker head 50 of plunger 37 to be abruptly thrown forward to its second position, illustrated in FIGURE 3.

As the plunger 37 continues to rotate the cam balls 53 and 36 disengage and the cam follower balls 35 engage the inclined surfaces of the clutch head cam teeth 44 and 45 to gradually retract the plunger to the first position, shown in FIGURE 2.

This hammering action is effected solely by the interplay of the several camming surfaces, without the use of any biasing springs.

Now referring to the drill 56, which is intended to be used with this hammering device, it will be noted that the drill has the usual bit end 57, with a conventional cutting tip 61, and a shank end 60.

Reference numeral 58 indicates an anvil portion of larger diameter than the shank 60 joined thereto through a flat circular strike face 59.

The shank 60, of the drill illustrated in FIGURE 4, is hexagonal in cross-section, of a size to slidably interfit the plunger bore 42 between the three steel balls 43, 43*a* and 43*b*, as seen most clearly in FIGURE 5. It will be evident that the shank is locked to the plunger 37 by the steel balls 43, 43*a* and 43*b*, against relative rotation, but is free to move longitudinally of the bore 42 at all times.

While the use of a six sided shank, and mating balls, has been shown, it is to be understood that any non-



circular mating configuration that will hold the drill and plunger against relative rotation, while leaving them free for relative axial movement, may be employed.

With this device the drill 56 is free at all times to travel longitudinally of its axis upon impact of the hammer strike-face 51 against end face 59 of the drill anvil 58.

The drill 56 is not rigidly connected to the plunger 37 or the motor drive shaft 23. It is merely positioned in the bore 42 of the plunger unit 37, and is free to be pulled out at any time.

It is kept in the bore 42 by pressing the so mounted drill against the work surface, not shown. There is no restraint on the axial movement of the hammer head 50, which is free to travel with the drill until its movement is stopped by the resistance of the work-piece being cut.

This device gives a true hammering action, such as had with a simple hand held star drill and hammer.

Everything is free floating, with no kick-back or damping of the hammer head blows. There is actual forward displacement of the drill 56, under impact, without limitation by the travel of the hammer head 50.

While the drill bit 57 is illustrated as being of unitary construction with the anvil 58 and shank 60, it is to be understood that the anvil 58 and shank 60 could be provided with a chucking element, so that a single anvil unit could be used with drill bits of different diameter.

It will now be clear that there has been provided a device which accomplishes the objectives heretofore set forth.

While the invention has been disclosed in its preferred form, it is to be understood that the specific embodiment thereof as described and illustrated herein is not to be considered in a limited sense, as there may be other forms or modifications of the invention which should also be constructed to come within the scope of the appended claims.

I claim:

1. In combination with a drill bit of the type having a cylindrical shoulder abutting a shank, of smaller diameter than the shoulder, and of non-circular cross-section, a rotary hammer device, comprising, a housing having a bore therethrough; a cylindrical bearing block immovably mounted within the housing bore, intermediate the ends thereof, the block having annular end faces and an axial bore therethrough; a two headed plunger mounted in the housing for rotary and axial movement, the plunger having a cylindrical hammer head at its forward end and a cylindrical clutch head at its rear end, spaced apart a distance greater than the width of the bearing block and joined through a shaft portion of reduced diameter, journaled in the bearing block, with the heads positioned on opposite sides thereof; each of the heads having an annular cam surface faced toward the adjacent bearing block annular end face, the plunger also having an axial bore therethrough adapted to receive and hold the non-circular drill shank in freely slidable but non-rotatable engagement; slidable coupling means on the clutch head for connecting the plunger to a rotary driving member mounted on the housing and held against axial movement; the hammer head having an annular striker face at the forward end thereof surrounding the plunger bore, and adapted to seat against the cylindrical shoulder of the drill shank positioned in the plunger bore; co-operating cam means on said plunger and bearing block for imparting reciprocating axial movement to the plunger when the plunger is rotated in the housing, said co-operating cam means comprising a plurality of circularly arranged stationary camming portions on both annular end faces of the bearing block and a plurality of co-operating circularly arranged camming portions on the hammer and clutch head surfaces faced toward their respective bearing block end faces, the camming portions on the hammer head being displaced circumferentially relative to those on the clutch head, whereby, upon rotation, the plunger hammer head is moved axially between a first, retracted position wherein the hammer head

is proximate the bearing block when the camming surfaces on the clutch head and bearing block are engaged, and a second, advanced, position wherein the hammer head is spaced forwardly of and away from the bearing block, when the camming surfaces on the hammer head and bearing block are engaged, to impact freely against the drill bit collar.

2. In combination with a drill bit of the type having a cylindrical shoulder abutting a shank, of smaller diameter than the shoulder, and of non-circular cross-section, a rotary hammer device, comprising, a housing having a bore therethrough; a cylindrical bearing block immovably mounted within the housing bore, intermediate the ends thereof, the block having front and rear annular end faces, and an axial bore therethrough; a two headed plunger mounted in the housing for rotary and axial movement, the plunger having a cylindrical hammer head at its forward end and a cylindrical clutch head at its rear end, spaced apart a distance greater than the width of the bearing block and joined through a shaft portion of reduced diameter, journaled in the bearing block, with the heads positioned on opposite sides thereof; the clutch head having an annular cam surface faced toward the bearing block rear face, the hammer head having an annular cam surface faced toward the bearing block front face, the plunger also having an axial bore therethrough adapted to receive and hold the non-circular drill shank in freely slidable but non-rotatable engagement; slidable coupling means on the clutch head for connecting the plunger to a rotary driving member mounted on the housing and held against axial movement; the hammer head having an annular striker face at the forward end thereof surrounding the plunger bore, and adapted to seat against the cylindrical shoulder of the drill shank positioned in the plunger bore; a plurality of spaced and circularly arranged and aligned steel cam follower balls seated in both the front and rear annular end faces of the bearing block; a plurality of circularly spaced upwardly inclined cam teeth positioned on the clutch head faced toward the bearing block rear end face and engageable with the cam follower balls thereof; and, a plurality of steel cam balls seated in the annular cam surface of the hammer head and engageable with the cam follower balls of the front annular end face of the bearing block, the camming balls on the hammer head being displaced circumferentially relative to the cam teeth of the clutch head, whereby, upon rotation, the plunger hammer head is moved axially between a first, retracted, position, wherein the hammer head is proximate the bearing block when the camming balls and teeth of the bearing block and clutch head are engaged, and a second, advanced, position wherein the hammer head is spaced forwardly of and away from the bearing block when the camming balls of the hammer head and bearing block are engaged, to impact freely against the drill bit collar.

3. A rotary hammer device according to claim 2 wherein the cylindrical hammer and clutch heads of the plunger have a plurality of bearing balls embedded in the peripheral surfaces thereof which ride against the housing bore wall.

4. A rotary hammer device according to claim 2 wherein the slidable coupling means on the clutch head comprises a diametric slot cut in the rear end face of the cylindrical clutch head engaged by a mating key mounted on the rotary driving member mounted on the housing, said key being of the same shape as the slot, but of slightly smaller dimensions, so as to slidably engage the slot, thereby permitting the plunger to move axially relative to the clutch key, while holding it against relative rotation thereto.



5. A rotary hammer device according to claim 2 and including means for securing said housing to the case of a portable electric motor, said means on said member being adapted to drivingly engage the rotary driven part of the motor.

6. In combination with a drill bit holding chuck of the type having a cylindrical shoulder abutting a shank of smaller diameter than the shoulder, and of non-circular cross-section, a rotary hammer device, comprising, a housing having a bore therethrough; a cylindrical bearing block immovably mounted within the housing bore, intermediate the ends thereof, the block having annular end faces and an axial bore therethrough; a two headed plunger mounted in the housing for rotary and axial movement, the plunger having a cylindrical hammer head at its forward end and a cylindrical clutch head at its rear end, spaced apart a distance greater than the width of the bearing block and joined through a shaft portion of reduced diameter, journaled in the bearing block, with the heads positioned on opposite sides thereof; each of the heads having an annular cam surface faced toward the adjacent bearing block annular end face, the plunger also having an axial bore therethrough adapted to receive and hold the non-circular chuck shank in freely slidable but non-rotatable engagement; slidable coupling means on the clutch head for connecting the plunger to a rotary driving member mounted on the housing and held against axial movement; the hammer head having an annular striker face at the forward end thereof surrounding the plunger bore, and adapted to seat against the cylindrical shoulder of the chuck shank positioned in the plunger bore; co-operating cam means on said plunger and bearing block for imparting reciprocating axial movement to the plunger when the plunger is rotated in the housing, said co-operating means comprising a plurality of circularly arranged stationary camming portions on both annular end faces of the bearing block and a plurality of co-operating circularly arranged camming portions on the hammer and clutch head surfaces faced toward their respective bearing block end faces, the camming portions on the hammer head being displaced circumferentially relative to those on the clutch head, whereby, upon rotation, the plunger hammer head is moved axially between a first, retracted, position wherein the hammer head is proximate the bearing block when the camming surfaces on the clutch head and bearing block are engaged, and a second, advanced, position wherein the hammer head is spaced forwardly of and away from the bearing block, when the camming surfaces on the hammer head and bearing block are engaged, to impact freely against the drill bit collar.

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